(19) (YU) YUGOSLAVIA

(12) PATENT APPLICATION B2

(51) Int. Cl. [4]: F 28G 13/00

FEDERAL PATENT OFFICE
BELGRADE

(21) Application No.: P 1728/88

(22) Application submission date: 9.13.1988

(41) Date laid open: 3.14.1990
PG 1/1990 p. 412
(43) Application publication date: 2.20.1992
PG 4/1991 p. 776

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(54) Title: DEVICE FOR RELIABLE DETONATION-IMPULSE CLEANING OF THE HEATING SURFACES OF POWER ENGINEERING AND OTHER BOILERS DURING OPERATION

(57) Abstract:

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Device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during operation

Area of technology of the invention:

The invention lies in the field of power engineering, especially the field of application of shock waves for periodic cleaning of the heating surfaces of power engineering and other boilers without halting the operation.

According to the International Patent Classification the invention corresponds to symbol F 28 G 13/00.

Technical problem:

The technical problem which is solved by this invention is defined as follows: how to clean the flame-smoke side of heating surfaces without shutting down the boiler. How to design it so that this cleaning is provided by a series of shock waves that will be generated by detonation combustion of suitable reagents in a special device situated outside of the boiler. How, during the time of filling of the device with a mixture of explosive reagents, and without installing closure elements, to prevent the penetration of boiler smoke gases and ash inside the device for detonation-impulse cleaning and at the same time how to ensure that the technical solution to this problem interferes the least with the propagation of the shock waves from the device into the boiler volume. How to ensure that the technical solution of the mentioned problem is sufficient even when the open end of the device for detonation-impulse cleaning is introduced into the zones of the boiler with high temperature and/or temporary excess pressure in the smoke gases. How to enable, by a particular design solution, the undisturbed working or effective reactivation of the device even in the event that its interior nevertheless gets fouled with ash or condensate from the boiler smoke gases and, finally, how to enable the device for impulse-detonation cleaning

to work reliably even under conditions of temporary or lengthy unavailability of the sealing medium.

The defined technical problem is solved by this invention

DEVICE FOR RELIABLE DETONATION-IMPULSE CLEANING OF THE HEATING SURFACES OF POWER ENGINEERING AND OTHER BOILERS DURING OPERATION

Prior art:

In the existing practice, for removal of deposits from the flame-smoke side of boiler heating surfaces, a number of conventional methods are used, with more or less success, such as water or steam blowers, "steel rain", vibrators, and the like. More recently, however, essentially new methods are also being developed for this purpose. One of them is the method of detonation-impulse cleaning, which has been developed since the early seventies in the USSR (Kazan University and "Uralenergochermet") and in Czechoslovakia (VUZES -- Brno). The method is based on removing deposits by shock waves of controlled intensity, which are generated by detonation combustion of suitable reagents introduced into a specially shaped detonation volume, situated outside the boiler. Previously measured and mixed reagents are introduced directly into the detonation volume, which is usually in the form of a pipe with one closed end (the detonation pipe), and they are then burned directly in the detonation volume, usually by an automotive spark plug installed in the wall, near the closed end of the pipe.

The supplying and igniting of the mixture alternate periodically, and the shock waves produced are emitted into the boiler through the second, open end of the detonation pipe, which end does not have any closure elements, and is not outfitted with any other elements to prevent the penetration of smoke gases and ash from the interior of the boiler into the space of the detonation pipe intended for generation of the shock waves.

This device for detonation-impulse cleaning of boiler heating surfaces can work successfully only on certain boilers, and only if connected by its open end to a specially chosen sites of these boilers. Otherwise, because of pulsations during the combustion in the boiler, smoke gases and ash will get from the boiler into the interior of the detonation pipe, which passivates the entire device for detonation-impulse cleaning, renders it very unsafe

in operation, or permanently disables it. The detonation pipes of the device with this design are also subject to physical failure, both on account of the intense heat transfer from the pulsating smoke gases from the boiler to the walls of the open end of the pipe, and on account of the aggressive action of the solution of sulfuric acid formed by condensation of a portion of the smoke gases at its closed end.

Description of the solution of the technical problem:

The invention entitled "Device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during operation" is shown on the drawings, namely:

Fig. 1 -- shows the invention in two basic projections: profile and top view.

Fig. 2 -- shows feature "x" in transverse and lengthwise section; detail of the sealing of the open end of the detonation pipe.

Fig. 3 -- shows a view of the invention in section A-A, showing the structural design of the system for suctioning of smoke gases from inside the detonation pipe, as well as for separation of ash from the suctioned smoke gases.

Fig. 4 -- shows section B-B through the system for suctioning of smoke gases from inside the detonation pipe, in which separation of ash from the suctioned smoke gases is provided.

The structural design of this invention eliminates the shortcomings mentioned in the prior art, since the open end of the device for reliable detonation-impulse cleaning of the heating surfaces is realized with a sealing system (items 10-15 and item 29, Fig. 1 and 2), whose nozzles (10) are positioned so as to interfere minimally with the nature of the generated shock waves, while at the same time, by suitably directed jets of an appropriate medium, such as air, sufficiently developed exactly at the open end of the device, they prevent the penetration of boiler smoke gases and ash into the detonation pipe (1), while also affording a cooling of the walls of the detonation pipe at its open end. By this structural design, the electrical ignition source (4) is situated outside of the wall of the detonation pipe and installed in an auxiliary pipe (5), which is connected by a throttle (3) to the main line (2) for filling the detonation pipe with reagents, thereby enabling igniting of the mixture and

undisturbed functioning of the device even in event of a certain amount of ash getting into and remaining in the interior of the detonation pipe.

In the event that, out of necessity, a rather large quantity of ash or condensate builds up inside the detonation pipe, the entire device for detonation-impulse cleaning can easily be reactivated in that the contaminants built up at the closed end of the detonation pipe are removed through a suitable opening (7) with cover (8), and after this the contaminants are removed from the inside of the walls of the detonation pipe by generating several initial shock waves into the atmosphere through a maintenance opening (6) situated in an appropriate place. Of course, in the event that the boiler plant does not have the proper medium available for a short time, or in general, which is needed to supply the nozzles (10) for sealing the open end of the detonation pipe, it is possible to suck out the ash-laden smoke gases by means of the boiler's or a certain other ventilator from the device for detonation-impulse cleaning through several suction pipes (16), manifolds for inertial and gravitational separation of ash (17), and suction pipes (22) with fittings for adjustment of partial vacuum (23) and (24).

The design of the device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during operation includes, as one of its main elements, a detonation pipe (1), which is closed at one end, while at its other, open end, serving to emit the shock waves produced into the boiler space, it is realized without closure elements. The detonation pipe at the open end can, if required, branch into two or more outlets, which lead into the interior of the boiler (31) at certain locations. The open end of the detonation pipe (1) freely expands in relation to the structure of the boiler, while the seal of the boiler in relation to the atmosphere is protected at this place by means of packing boxes (9).

Penetration of boiler smoke gases and ash into the inside of the device is prevented by the design of the system for sealing the open end of the detonation pipe by fluid jets. This sealing system also serves to cool the walls in the zone of the open end of the detonation pipe, and it consists of a suitable number of appropriately placed nozzles (10) connected to manifolds (11), whose number corresponds to the number of branches of the open end of the detonation pipe. The manifolds (11) of the sealing system are connected by flanged joints and PARRAP accordion pipes (12) to the fluid distribution pipe (13), in which are installed a regulating (14) and a shutoff (15) valve, after a blower (29). The amount (1) by which the sealing nozzles (10) are situated before the open end of the detonation pipe (1),

as well as the diameter of the outlet cross section of the nozzles (d_0), that is to say the radial angle (φ) and axial angle of their positioning (γ), are such (Fig. 2) that the jets precisely at the open end of the detonation pipe are sufficiently developed (d_k) for a symmetrical arrangement, and with minimal energy dissipation they overlap each other sufficiently, making a curtain having sufficient momentum available to it at the open end of the detonation pipe, which curtain is impermeable to the boiler smoke gases and ash. The sealing system thus installed, in a mechanical sense, does not substantially influence the emission of the shock waves from the device for detonation-impulse cleaning into the boiler. The device is filled with explosive mixture at two levels, located at the closed end, in such a way that previously measured quantities of reagents, after being mixed, are forced into the interior of the detonation pipe (1) across a check valve (25), and then across the main (2) and auxiliary (5) filling pipe. The flow through the auxiliary pipe (5), which serves for the initial ignition of the mixture and in which is placed an ignition source - an electric spark generator (4), is regulated by selection of an appropriate throttle (3). In this way, the ignition source (4) is protected from the passivating action of the ash and condensate from the smoke gases which might nevertheless get into the interior of the device, and the device also functions reliably in such conditions, except for this. Larger quantities of ash and/or condensate that build up inside the device - the detonation pipe (1) in exceptional situations, such as a lengthy standstill, can be removed through the opening (7), on which there is a lid (8) connected by screws. Reactivation of the device in the sense of knocking down the ash from the inner surface of the walls of the detonation pipe will be done in this case by generating several initial shock waves into the atmosphere through the maintenance opening, whose cover (6) is reinforced by a beam (26), which is tightened by screws (27). The maintenance opening with cover (6) is placed behind a turbulizer (28), and in relation to the closed end of the detonation pipe it is placed at a distance equal to at least fifteen times the cross sectional diameter of the detonation pipe. In situations where, out of necessity, there is a temporary interruption or the boiler plant cannot generally obtain any suitable medium for the sealing (which can be, for example, heated or cooled air, compressed to 2-4 kPa), the smoke gases of moderate temperature can be sucked out from the device by means of the boiler's or some other fan (30), through several pipes (16), arranged symmetrically about the periphery of the detonation pipe and making an acute angle (δ) in relation to the possible flow of smoke gases, said pipes being connected to a manifold in the form of a torus (17). At the bottom end, the manifold (17) terminates in a hopper (18), which serves to keep the ash separated from the smoke gases during the flow through the manifold, and is emptied periodically from the hopper by opening a threaded cover (19). The smoke gases, partially freed of ash, are taken away from the top part of the

manifold by an axial compensator with flanges (21) and a suction pipe (22). Shutoff and regulating fittings (23) and (24) serve to regulate the partial vacuum in the manifold (17).

Patent claims:

1. Device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during operation, characterized in that the ignition source (4) is placed outside of the detonation pipe (1) and situated in an auxiliary filling pipe (5), in that the auxiliary filling pipe (5) is connected, via a throttle (3), to the main filling pipe (2), upstream from which is placed a return valve (25), in that at the closed end of the detonation pipe (1) there is made a cleaning opening (7) with flanged cover (8), and in that on the detonation pipe (1), behind a turbulizer (28), there is made a maintenance opening, which also serves to reactivate the chamber by occasional generation of shock waves into the atmosphere, with a cover (6) that is reinforced by a beam (26) secured by screws (27).

2. Device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during operation as claimed in claim 1, characterized in that, upstream from the open end of the detonation pipe (1), there is placed a sealing system, which consists of an appropriate number of suitably positioned nozzles (10), connected to manifolds (11), which are joined by means of PARRAP accordion pipes with flanges (12) to a distribution pipe for supplying an appropriate sealing fluid (13), which is pressurized by a fan (29), and in that a regulating (14) and a shutoff (15) valve are placed on the pipe for supply of sealing fluid (13) behind the fan (29).

3. Device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during operation as claimed in claim 1, characterized in that, at an appropriate place on the detonation pipe (1), at an acute angle with respect to the possible flow of boiler smoke gases, there is placed a sufficient number of pipes for suctioning of smoke gases and ash (16), arranged uniformly about the periphery of the detonation pipe, being connected to a manifold in the form of a torus (17), whose bottom part terminates in a hopper (18) with a threaded cover (19), which is used for occasional emptying of the ash separated from the smoke gases, in that the upper part of the manifold (17) is designed with a cover for cleaning (20), while it is connected via an axial compensator with flanges (21) to a suction pipe (22), having a built-in stop valve (23) and regulating valve (24) for adjusting the partial vacuum in the manifold (17), and in that the suction pipe (22) is connected to the intake side of the fan (30).

4. Device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during operation as claimed in claim 2, characterized in that, in the system for sealing the open end of the detonation pipe (1), in place of the blower (29), one may alternatively use heated or cooled air from the boiler's heating system, such that the distribution pipe for supplying sealing fluid (13) with a regulating (14) and a shutoff (15) valve is connected to the appropriate place of the fresh air channel, which is joined to the pressure side of the boiler pressure fans.

5. Device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during operation as claimed in claim 3, characterized in that, as an alternative, one can omit the intake fan (13) from the system for suctioning of smoke gases and ash from the interior of the detonation pipe (1), such that the suction pipe (22) with shutoff (23) and regulating (24) valve is connected to the intake side of the fan for suctioning of smoke gases from the boiler.

Summary of the essence of the invention:

The invention refers to a device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during operation, by means of which shock waves of controlled intensity are generated by detonation combustion of suitable reagents and emitted into the gas space of a boiler. The device differs in design from the known solutions in that the electric ignition source is placed outside of the detonation pipe and installed in a special pipe for auxiliary filling, in which pipe the flow of reagents is adjusted by selection of an appropriate throttle, and in that together with appropriately positioned openings for cleaning of the detonation pipe and initial generating of shock waves into the atmosphere the device is rendered reliable in operation and suitable for reactivation after lengthy standstills. Furthermore, in order to prevent penetration of boiler smoke gases and ash into the interior of the device, at the open end of the detonation pipe there is placed a system for sealing by jets of appropriate fluid, e.g. compressed air, and in event of unavailability of fluid for sealing, the smoke gases can be sucked out from the device by a special system which, after separation of the ash, is connected to the intake of the boiler smoke gas fans.

Proposal for best method of economical use of the invention

The device for reliable detonation-impulse cleaning of loose deposits which are usually deposited in the convective portion of a boiler can also be used successfully for removal of harder deposits laid down in the furnace. It is easiest to generate the shock waves by burning a suitable, previously prepared mixture of TNG and air. The length of the detonation pipe must be such as to enable full development of the wave before it reaches the open end, and the acoustic power of the device, which is a function of the volume of the detonation pipe, is chosen in accordance with the thermal power of the boiler for which the device is intended. However, it can be recommended that the shock waves be generated by burning 0.5-1.2 Nm^3 of a suitable mixture of TNG and air under atmospheric conditions in a device whose detonation pipe is 15-25 m long, and whose diameter is 0.2-0.35 m; the speed of the mixture through the auxiliary filling pipe in which the ignition source is placed should not exceed 1.5 m/s, or be less than 0.5 m/s, the turbulizer should be placed 1.2-1.6 m away from the closed end of the detonation pipe, air from the heating system of the boiler should be used for sealing the open end of the device, while 3-5 nozzles with diameter of 20-40 mm should be placed 0.6-1.0 m before the open end of the detonation pipe at an axial angle of 5-10 degrees, and they should be radially turned at an angle of 25-35 degrees. The systems for suctioning of smoke gases should not be placed too close to the open end of the device, while 4 to 6 pipes for suctioning gases and ash from the device of diameter 40-70 mm should be uniformly distributed about the periphery of the detonation pipe, at an angle of 30 degrees in relation to the possible flow of smoke gases through the detonation pipe. The partial vacuum in the suction manifold should not be more than 100-150 Pa. The cleaning of the boiler should be organized so as to generate sufficiently frequently (1 to 6 times in 24 hours) series of 10 to 20 shock waves, and so that the last waves in the series will be the strongest.

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Device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during opreration

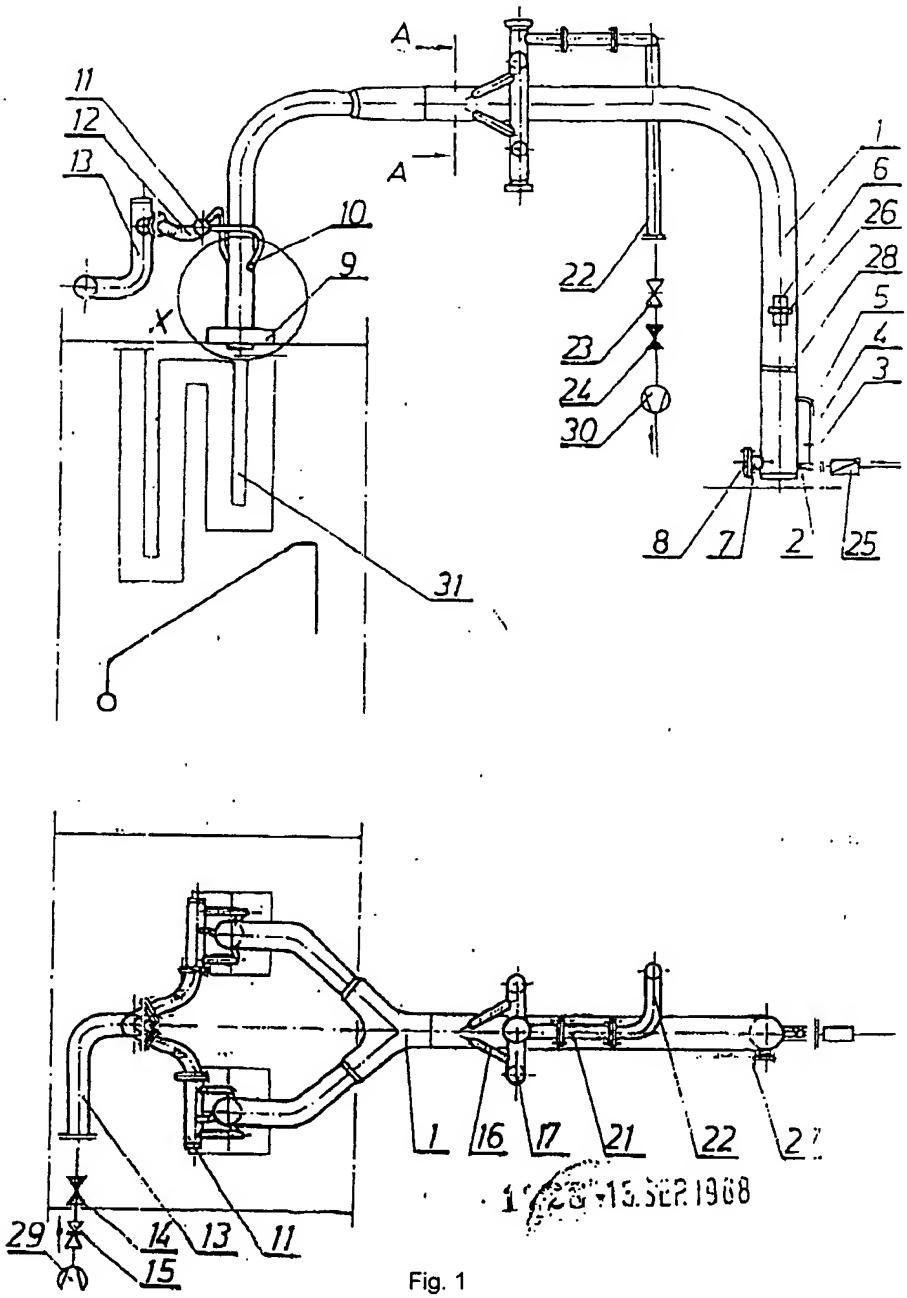

Fig. 1

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Device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during opreration

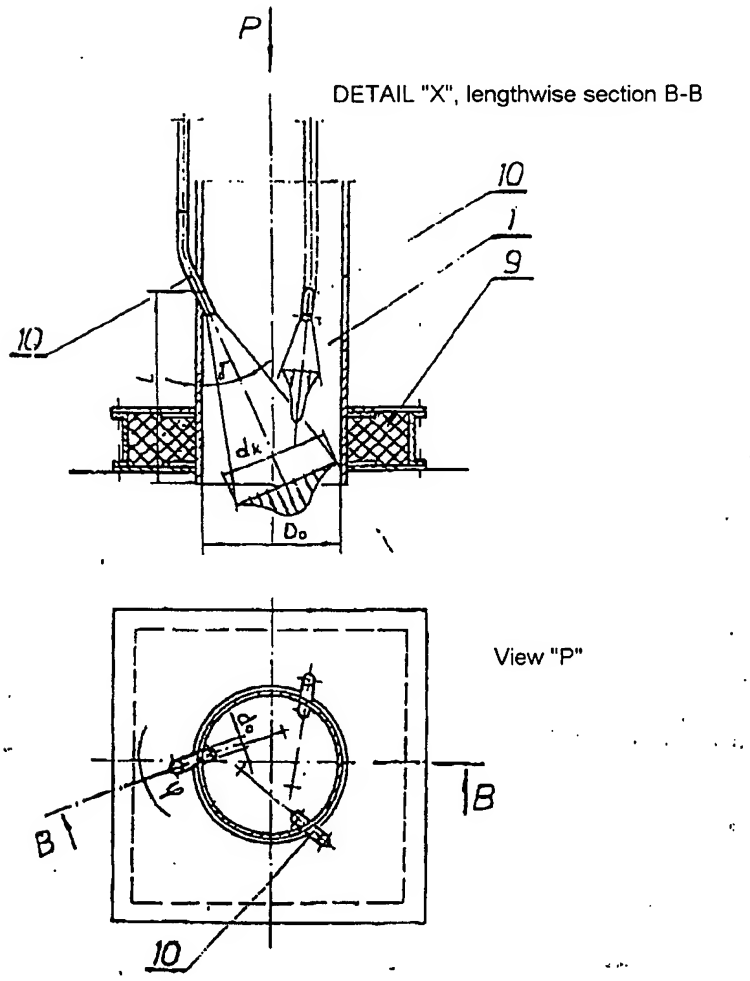

Fig. 2

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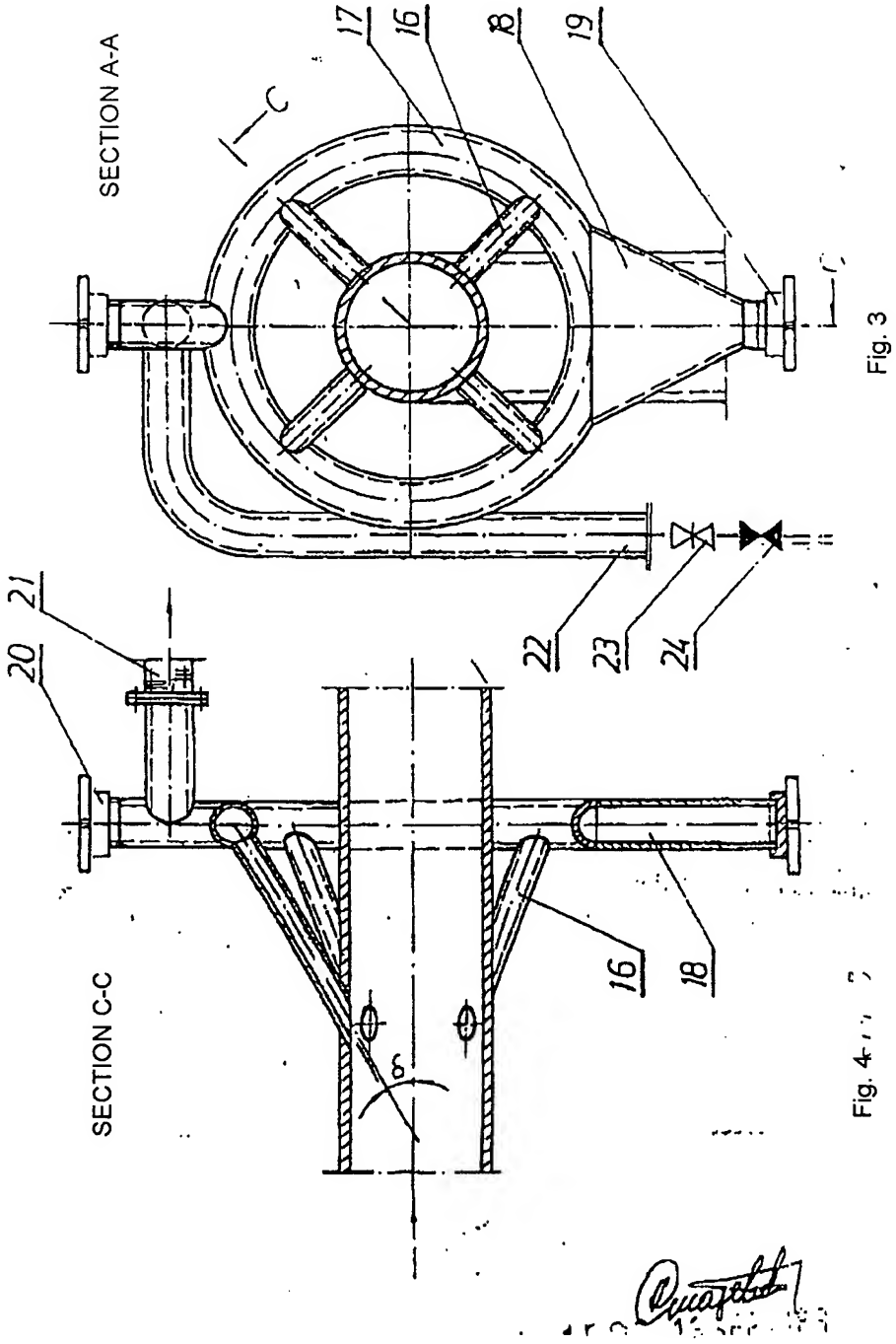
Device for reliable detonation-impulse cleaning of the heating surfaces of power engineering and other boilers during opreration



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(12) OBJAVLJENA PRIJAVA PATENTA B2

(51) Int. Cl.[4] F 28G 13/00

SAVEZNI ZAVOD ZA PATENTE
BEOGRAD

(21) Broj prijave: P 1728/88

(22) Datum podnošenja prijave: 13.09.1988.

(41) Datum od koga se prijava mogla razgledati: 14.03.1990.
PG 1/1990 str.412

(43) Datum objavljivanja prijave: 20.02.1992.
PG 4/1991 str.776

(45) Datum objavljivanja patenta:

(30) Međunarodno pravo prvenstva:

(61) Dopunski patent uz osnovni patent broj:

(62) Izdvojen patent iz prvobitne

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(54) Naziv: UREDJAJ ZA POUZDANO DETONACIONO-IMPULSNO ČIŠĆENJE GREJNIH POVRŠINA ENERGETSKIH I DRUGIH KOTLOVA TOKOM POGONA

51) Int. Cl[4]. F 28G 13/00

(57) Apstrakt:

YU P 1728/88 B2

A/A ZA1728/88/1 od 02.10.1997.

P 1728/88

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UREDJAJ ZA POUZDANO DETONACIONO-IMPULSNO ČIŠĆENJE GREJNIH POVRŠINA ENERGETSKIH I DRUGIH KOTLOVA TOKOM POGONA

Oblast tehnike u koju spada pronalazak

Pronalazak spada u oblast energetike, posebno u oblast primjene detonacionih talasa za periodično čišćenje grejnih površina energetskih i drugih kotlova bez obustave pogona.

Prema medjunarodnoj klasifikaciji patenata pronalasku odgovara simbol F 28 G 13/00.

Tehnički problem:

Tehnički problem koji se rješava ovim pronalaskom je definisan na sljedeći način: Kako čistiti plameno-dimnu stranu ogrijevnih površina bez obustavljanja kotla. Kako konstrukcijski riješiti da se to čišćenje obavlja serijom udarnih talasa koji će se generisati detonacionim sagorijevanjem pogodnih reagenasa u posebnom uredjaju smještenom izvan kotla. Kako, za vrijeme punjenja uredjaja smješom eksplozivnih reagenasa, a bez instaliranja zapornih organa, spriječiti prodor kotlovskih dimnih plinova i pepela u unutrašnjost uredjaja za detonaciono-impulsno čišćenje i kako istovremeno postići da tehničko rješenje ovog problema u što manjoj mjeri remeti propagaciju udarnih talasa iz uredjaja u zapreminu kotla. Kako postići da tehničko rješenje navedenog problema zadovoljava i pri uvodjenju otvorenog kraja uredjaja za detonaciono-impulsno čišćenje u zone kotla sa visokom temperaturom i/ili povremenim nadtlakom u dimnim plinovima. Kako, odredjenim konstrukcionim rješenjem omogućiti nesmetan rad, ili efikasno reaktiviranje uredjaja i u slučaju da se njegova unutrašnjost, ipak, zaprlja pepelom ili kondenzatom iz kotlovskih dimnih plinova i na kraju kako omogućiti da uredjaj za impulsno-detonaciono čišćenje radi pouzdano i u uslovima povremenog ili trajnog neraspolaganja medijem za brtvljenje.

Definisani tehnički problem je riješen ovim pronalaskom

UREDJAJA ZA POUZDANO DETONACIONO-IMPULSNO ČIŠĆENJE GREJNIH POVRŠINA ENERGETSKIH I DRUGIH KOTLOVA TOKOM POGONA

Stanje tehnike:

U postojećoj praksi se, za odnošenje naslaga sa plameno-dimne strane kotlovskih ogrijevnih površina, sa više ili manje uspjeha, koristi niz konvencionalnih postupaka, kao što su vodeni ili parni duvači gara, čelična kiša, vibratori i slično. U novije vrijeme se, medjutim, za iskorištavanje u tu svrhu, razvijaju i suštinski novi postupci. Jedan od takvih je postupak detonaciono-impulsnog čišćenja, koji se od početka sedamdesetih godina razvija u SSSR-u (Kazanski univerzitet i "Uralenergočermet") i u ČSSR-u (VUZES - Brno). Postupak se bazira na odnošenju naslaga udarnim talasima kontrolisane jačine koji se generišu detonacionim sagorijevanjem pogodnih reagenasa uvedenih u posebno oblikovanu-detonacionu zapreminu, smještenu izvan kotla. U detonacionu zapreminu, koja je obično u obliku cijevi sa jednim zatvorenim krajem (detonaciona cijev), se direktno uvode ranije odmjereni i izmješani reagensi, koji se zatim, obično automobilskom svjećicom postavljenom u zidu - blizu zatvorenog kraja cijevi, pale neposredno u detonacionoj zapremini.

Dovod i paljenje smješe se periodično smjenjuju, a proizvedeni udarni talasi se u unutrašnjost kotla emituju kroz drugi, otvoreni, kraj detonacione cijevi, koji je bez zapornih organa i koji nije opremljen ni drugim elementima za sprječavanje prodora dimnih plinova i pepela iz unutrašnjosti kotla u prostor detonacione cijevi namijenjen za generisanje udarnih talasa.

Ovakav uredjaj za detonaciono-impulsno čišćenje kotlovskih grejnih površina može uspješno raditi samo na nekim kotlovima i to samo ako je otvorenim krajem priključen na posebno izabrana mjesta tih kotlova. U protivnom, zbog pojave pulzacija tokom sagorijevanja u kotlu, dimni plinovi i pepeo prodiru iz kotla u unutrašnjost detonacione cijevi što čitav uredjaj za detonaciono-impulsno čišćenje pasivizira, čini ga vrlo nesigurnim u radu, ili ga trajno onesposobljava. Detonacione cijevi uredjaja ovakve konstrukcije su podložne i fizičkom propadanju, kako zbog intenzivnog prenosa toplote sa pulzirajućih dimnih plinova iz kotla na zidove otvorenog kraja cijevi, tako i zbog agresivnog djelovanja rastvora sumporne kiseline nastalog kondenzacijom dijela dimnih plinova uz njen zatvoreni kraj.

Opis rješenja tehničkog problema:

Pronalazak naslovljen kao: "Uredjaj za pouzdano detonaciono-impulsno čišćenje grejnih površina energetskih i drugih kotlova tokom pogona" je prikazan na crtežima i to:

Slika 1 - prikazuje pronalazak u dvije osnovne projekcije; nacrt i tlocrt pronalaska

Slika 2 - prikazuje detalj "x" u poprečnom i uzdužnom presjeku; detalj brtvljenja otvorenog kraja detonacione cijevi

Slika 3 - prikazuje izgled pronalaska u presjeku A-A, u kojem je pokazano konstruktivno rješenje sistema za odsis dimnih plinova iz unutrašnjosti detonacione cijevi, kao i za separaciju pepela iz odsisanih dimnih plinova.

Slika 4 - prikazuje presjek B-B kroz sistem za odsis dimnih plinova iz unutrašnjosti detonacione cijevi u kojem se obavlja i separacija pepela iz odsisanih dimnih plinova.

Konstruktivnim rješenjem ovog pronalaska eliminisani su nedostaci navedeni u stanju tehnike, jer je otvoreni kraj uredjaja za pouzdano detonaciono-impulsno čišćenje grejnih površina izveden sa sistemom za brtvljenje (poz. 10 do 15 i poz. 29 - slike 1 i 2), čije su mlaznice (10) postavljene tako da u minimalnoj mjeri remete karakter generisanih udarnih talasa, a da istovremeno, pogodno usmjerenim i upravo na otvorenom kraju uredjaja dovoljno razvijenim mlazevima odgovarajućeg medija - npr. vazduha, spriječe prodor kotlovskih dimnih plinova i pepela u detonacionu cijev (1), kao i da obezbijede hladjenje zidova detonacione cijevi uz njen otvoreni kraj. Datim konstruktivnim rješenjem je električni izvor paljenja (4) izmješten iz zida detonacione cijevi i postavljen u pomoćnu cijev (5) koja je preko prigušnice (3) vezana na glavnu liniju (2) za punjenje detonacione cijevi reagensima čime je omogućeno paljenje smješe i nesmetan rad uredjaja čak i u slučaju da izvjesna količina pepela prodre i zaostane u unutrašnjosti detonacione cijevi.

U slučaju da se, iz razloga više sile, u unutrašnjosti detonacione cijevi nakupi veća količina pepela ili kondenzata cijeli uredjaj za detonaciono-impulsno čišćenje je moguće lako reaktivirati na taj način da se nečistoće nakup-

ljene uz zatvoren kraj detonacione cijevi odstrane kroz odgovarajući otvor (7) sa poklopcem (8), a nakon toga da se nečistoće sa unutrašnje strane zidova detonacione cijevi odstrane generisanjem nekoliko prvih udarnih talasa u atmosferu kroz, na odgovarajućem mjestu postavljen, revizioni otvor (6). Konačno u slučaju da kotlovnica na kraće vrijeme, ili uopšte, ne raspolaže odgovarajućim medijem potrebnim za napajanje mlaznica (10) kojima se brtvi otvoreni kraj detonacione cijevi, dimne plinove zasićene pepelom je, pomoću kotlovskog ili nekog drugog ventilatora, moguće odsisati iz uredjaja za detonaciono-impulsno čišćenje preko više cijevi za odsis (16), kolektora sa inercionom i gravitacijskom separacijom pepela (17) i odsisne cijevi (22) sa armaturom za regulaciju podtlaka (23) i (24).

U sklopu uredjaja za pouzdano detonaciono-impulsno čišćenje grejnih površina energetskih i drugih kotlova tokom pogona, kao jedan od osnovnih elemenata, se postavlja detonaciona cijev (1), koja je na jednom kraju zatvorena, a na drugom - otvorenom kraju koji služi za emitovanje proizvedenih udarnih talasa u kotlovski prostor, je izvedena bez zapornih organa. Detonaciona cijev se na otvorenom kraju, po potrebi, grana u dva ili više izlaza koji se na odredjenim mjestima uvode u unutrašnjost kotla (31). Otvoreni kraj detonacione cijevi (1) slobodno dilatira u odnosu na konstrukciju kotla, a hermetičnost kotla na ovom mjestu u odnosu na atmosferu je očuvana uz pomoć kutija za dihtovanje (9).

Prodor kotlovskih dimnih plinova i pepela u unutrašnjost uredjaja je spriječen konstrukcijom sistema za brtvljenje otvorenog kraja detonacione cijevi mlazevima fluida. Ovaj sistem za brtvljenje ujedno služi i za hladjenje zidova u zoni otvorenog kraja detonacione cijevi, a sastoji se iz odgovarajućeg broja pogodno postavljenih mlaznica (10) vezanih na kolektore (11) čiji broj odgovara broju račvi otvorenog kraja detonacione cijevi. Kolektori (11) sistema za brtvljenje su prirubničkim spojevima i harmonikastim PARRAP cijevima (12) vezani na cijev za distribuciju fluida (13) u koju su, iza tlačnog ventilatora (29), ugradjeni regulacioni (14) i zaporni ventil (15). Veličina (l) za koju su mlaznice za brtvljenje (10) postavljene ispred otvorenog kraja detonacione cijevi (1), kao i prečnik izlaznog presjeka mlaznica (d_o), odnosno radijalni ugao (φ) i aksijalni ugao njihovog postavljanja (γ) su takvi (slika 2) da su mlazevi, upravo na otvorenom kraju detonacione cijevi, dovoljno razvijeni (d_k), da su simetrično rasporedjeni i da se, uz minimalnu disipaciju energije, medjusobno dovoljno preklapaju čineći tako,uz dovoljnu količinu kretanja kojom ras-

polažu, zavjesu koja je, na otvorenom kraju detonacione cijevi, neprobojna za kotlovske dimne plinove i pepeo. Ovako postavljen sistem za brtvljenje, u mehaničkom smislu, ne utiče bitno na emisiju udarnih talasa iz uredjaja za detonaciono-impulsno čišćenje u kotao. Uredjaj se eksplozivnom smješom puni u dva nivoa, locirana uz zatvoren kraj, na taj način da se prethodno izmjerene količine reagenasa, nakon mješanja potiskuju u unutrašnjost detonacione cijevi (1) kroz nepovratnu klapnu (25), a zatim kroz glavnu (2) i pomoćnu cijev za punjenje (5). Protok kroz pomoćnu cijev (5), koja služi za početno paljenje smješe i u kojoj je smješten izvor paljenja - generator električne iskre (4), se reguliše izborom odgovarajuće prigušnice (3). Na ovaj način je izvor paljenja (4) zaštićen od pasivizirajućeg djelovanja pepela i kondenzata iz dimnih plinova koji bi eventualno, ipak prodrli u unutrašnjost uredjaja, pa uredjaj, osim izuzetno, i u takvim uvjetima radi pouzdano. Veće količine pepela i/ili kondenzata koje se, u izuzetnim prilikama - npr. kod dužeg prekida upotrebe, nakupe u unutrašnjosti uredjaja - detonacionoj cijevi (1), je moguće odstraniti kroz otvor (7) na koji je vijcima vezan poklopac (8). Reaktiviranje uredjaja u smislu obaranja pepela sa unutrašnje površine zidova detonacione cijevi, obaviće se, u tom slučaju, generisanjem nekoliko početnih udarnih talasa u atmosferu kroz revizioni otvor čiji je poklopac (6) ojačan gredom (26) koja je učvršćena vijcima (27). Revizioni otvor sa poklopcem (6) je postavljen iza turbulizatora (28), a u odnosu na zatvoreni kraj detonacione cijevi je postavljen na udaljenosti koja je najmanje jednaka petnaestorostrukom prečniku poprečnog presjeka detonacione cijevi. U slučajevima da, iz razloga više sile, nastupi privremen prekid ili kotlovnica uopšte ne raspolaže pogodnim medijem za brtvljenje (koji, npr., može biti zagrijan ili hladan vazduh stlačen na 2 ÷ 4 kPa) dimne plinove umjerene temperature je, pomoću kotlovskog ili nekog drugog ventilatora (30),moguće odsisati iz uredjaja preko više, po obimu detonacione cijevi, simetrično rasporedjenih i u odnosu na mogući tok dimnih plinova pod oštrim uglom (δ) postavljenih cijevi (16), koje su vezane na kolektor u obliku torusa (17). Na donjoj strani se kolektor (17) završava bunkerom (18) koji služi za odlaganje pepela što se za vrijeme toka kroz kolektor separiše iz dimnih plinova, a iz bunkera se ispušta povremenim otvaranjem poklopca sa navojem (19). Dimni plinovi djelimično oslobodjeni pepela se, preko aksijalnog kompenzatora sa prirubnicama (21) i odsisne cijevi (22), odvode iz gornjeg dijela kolektora. Zaporno regulaciona armatura (23) i (24) služi za regulaciju podtlaka u kolektoru (17).

Patentni zahtjev:

1. Uredjaj za pouzdano detonaciono-impulsno čišćenje grejnih površina energetskih i drugih kotlova tokom pogona, naznačen time, što je izvor paljenja (4) izmješten iz detonacione cijevi (1) i postavljen u pomoćnu cijev za punjenje (5), što je pomoćna cijev za punjenje (5), preko prigušnice (3), vezana na glavnu cijev za punjenje (2) pred kojom je postavljena povratna klapna (25), što je uz zatvoren kraj detonacione cijevi (1) napravljen otvor za čišćenje (7) sa prirubničkim poklopcem (8) i što je na detonacionoj cijevi (1), iza turbulizatora (28) napravljen revizioni otvor, koji služi i za reaktiviranje komore povremenim generisanjem udarnih talasa u atmosferu, sa poklopcem (6) koji je ojačan gredom (26) pričvršćenom vijcima (27).

2. Uredjaj za pouzdano detonaciono-impulsno čišćenje grejnih površina energetskih i drugih kotlova tokom pogona prema zahtjevu 1, naznačen time, što je pred otvorenim krajem detonacione cijevi (1) postavljen sistem za brtvljenje koji se sastoji iz odgovarajućeg broja pogodno postavljenih mlaznica (10) vezanih za kolektore (11) koji su pomoću harmonikastih PARNAP cijevi sa prirubnicama (12) spojeni na distributivnu cijev za dovod odgovarajućeg brtvenog fluida (13) koji se tlači ventilatorom (29) i što su na cijevi za dovod brtvenog fluida (13) iza ventilatora (29) postavljeni regulacioni (14) i zaporni ventil (15).

3. Uredjaj za pouzdano detonaciono-impulsno čišćenje grejnih površina energetskih i drugih kotlova tokom pogona prema zahtjevu 1, naznačen time, što je na odgovarajućem mjestu detonacione cijevi (1), pod oštrim uglom u odnosu na mogući tok kotlovskih dimnih plinova, postavljen dovoljan broj, po obimu detonacione cijevi, jednako rasporedjenih cijevi za odsis dimnih plinova i pepela (16), koje su vezane na kolektor u obliku torusa (17) čiji se donji dio završava bunkerom (18) sa poklopcem na navoj (19) koji služi za povremeno ispuštanje pepela separisanog iz dimnih plinova, što je gornji dio kolektora (17) izveden sa poklopcem za čišćenje (20), a preko aksijalnog kompenzatora sa prirubnicama (21) vezan za odsisnu cijev (22) u koju su ugradjeni zaporni ventil (23) i regulacioni ventil (24) za podešavanje podtlaka u kolektoru (17) i što je odsisna cijev (22) vezana na usisnu stranu ventilatora (30).

4. Uredjaj za pouzdano detonaciono-impulsno čišćenje grejnih površina energetskih i drugih kotlova tokom pogona prema zahtjevu 2, naznačen time, što se u sistemu za brtvljenje otvorenog kraja detonacione cijevi (1), umjesto tlačnog ventilatora (29), alternativno može koristiti zagrijan ili hladan vazduh iz sistema za loženje kotla na taj način da se distributivna cijev za dovod brtvenog fluida (13) sa regulacionim (14) i zapornim ventilom (15) veže na odgovarajuće mjesto kanala svježeg zraka koji je spojen sa tlačnom stranom kotlovskih potisnih ventilatora.

5. Uredjaj za pouzdano detonaciono-impulsno čišćenje grejnih površina energetskih i drugih kotlova tokom pogona prema zahtjevu 3, naznačen time, što se u sistemu za odsis dimnih plinova i pepela iz unutrašnjosti detonacione cijevi (1) alternativno može izostaviti isisni ventilator (13) na taj način da se odsisna cijev (22) sa zapornim (23) i regulacionim ventilom (24) veže na usisnu stranu ventilatora za odsis dimnih plinova iz kotla.

Kratak sadržaj suštine pronalaska:

Pronalazak se odnosi na uredjaj za pouzdano detonaciono-impulsno čišćenje grejnih površina energetskih i drugih kotlova tokom pogona pomoću kojeg se, detonacionim sagorijevanjem pogodnih reagenasa, generišu i u gasni prostor kotla emituju udarni talasi kontrolisane jačine. Uredjaj se od poznatih rješenja konstruktivno razlikuje po tome što je električni izvor paljenja izmješten iz detonacione cijevi i postavljen u posebnu cijev za pomoćno punjenje u kojoj se protok reagensa podešava izborom odgovarajuće prigušnice, a što, zajedno sa odgovarajuće postavljenim otvorima za čišćenje detonacione cijevi i početno generisanje udarnih talasa u atmosferu, uredjaj čini pouzdanim u radu i pogodnim za reaktiviranje nakon dužih zastoja. Osim toga, radi sprječavanja prodora kotlovskih dimnih plinova i pepela u unutrašnosti uredjaja, na otvorenom kraju detonacione cijevi je postavljen sistem za brtvljenje mlazevima odgovarajućeg fluida, npr. stlačenog vazduha, a za slučaj da se ne raspolaže fluidom za brtvljenje dimni plinovi se iz uredjaja mogu odsisavati posebnim sistemom koji se, nakon separacije pepela, veže na usis ventilatora kotlovskih dimnih plinova.

Navod o najboljem načinu za privrednu upotrebu pronalaska

Uredjaj za pouzdano detonaciono-impulsno čišćenje sipkih i rastresitih naslaga koje se obično deponuju u konvektivnom dijelu kotla se uspješno može primjeniti i za odnošenje tvrdjih naslaga deponovanih u ložištu. Najjednostavnije je udarne talase generisati spaljivanjem odgovarajuće, prethodno pripremljene, smješe TNG i vazduha. Dužina detonacione cijevi mora biti takva da omogućava potpun razvoj talasa prije njegovog nailaska na otvoren kraj, a akustična snaga uredjaja, koja je funkcija zapremine detonacione cijevi, se bira u skladu sa termičkom snagom kotla kojemu je uredjaj namijenjen. Ipak se može preporučiti da se udarni talasi generišu spaljivanjem 0,5 ÷ 1,2 Nm^3 odgovarajuće mješavine TNG i vazduha na atmosferskim uvjetima u uredjaju čija je detonaciona cijev dugačka 15 ÷ 25 m, a čiji je prečnik 0,2 ÷ 0,35 m, da brzina smješe kroz pomoćnu cijev za punjenje u kojoj je smješten izvor paljenja ne prelazi 1,5 m/s, niti da je manja od 0,5 m/s, da se turbulizator postavi 1,2 ÷ 1,6 m daleko od zatvorenog kraja detonacione cijevi, da se za brtvljenje otvorenog kraja uredjaja koristi vazduh iz sistema za loženje kotla pri čemu 3 ÷ 5 mlaznica prečnika 20 ÷ 40 mm treba postaviti za 0,6 ÷ 1,0 m ispred otvorenog kraja detonacione cijevi pod aksijalnim uglom 5 ÷ 10° i pri tome ih radijalno zakrenuti za ugao 25 ÷ 35°. Sistemi za odsis dimnih plinova ne treba postaviti suviše blizu otvorenom kraju uredjaja, pri čemu 4 ÷ 6 cijevi za odsis plinova i pepela iz uredjaja, prečnika 40 ÷ 70 mm, treba ravnomjerno rasporediti po obimu detonacione cijevi, pod uglom 30° u odnosu na moguć tok dimnih plinova kroz detonacionu cijev. Podtlak u odsisnom kolektoru ne treba biti veći od 100 ÷ 150 Pa.

Čišćenje kotla treba organizovati tako što će se dovoljno često (1 do 6 puta u 24 sata) generisati serije od 10 ÷ 20 udarnih talasa i to tako da zadnji talasi u seriji budu najjači.

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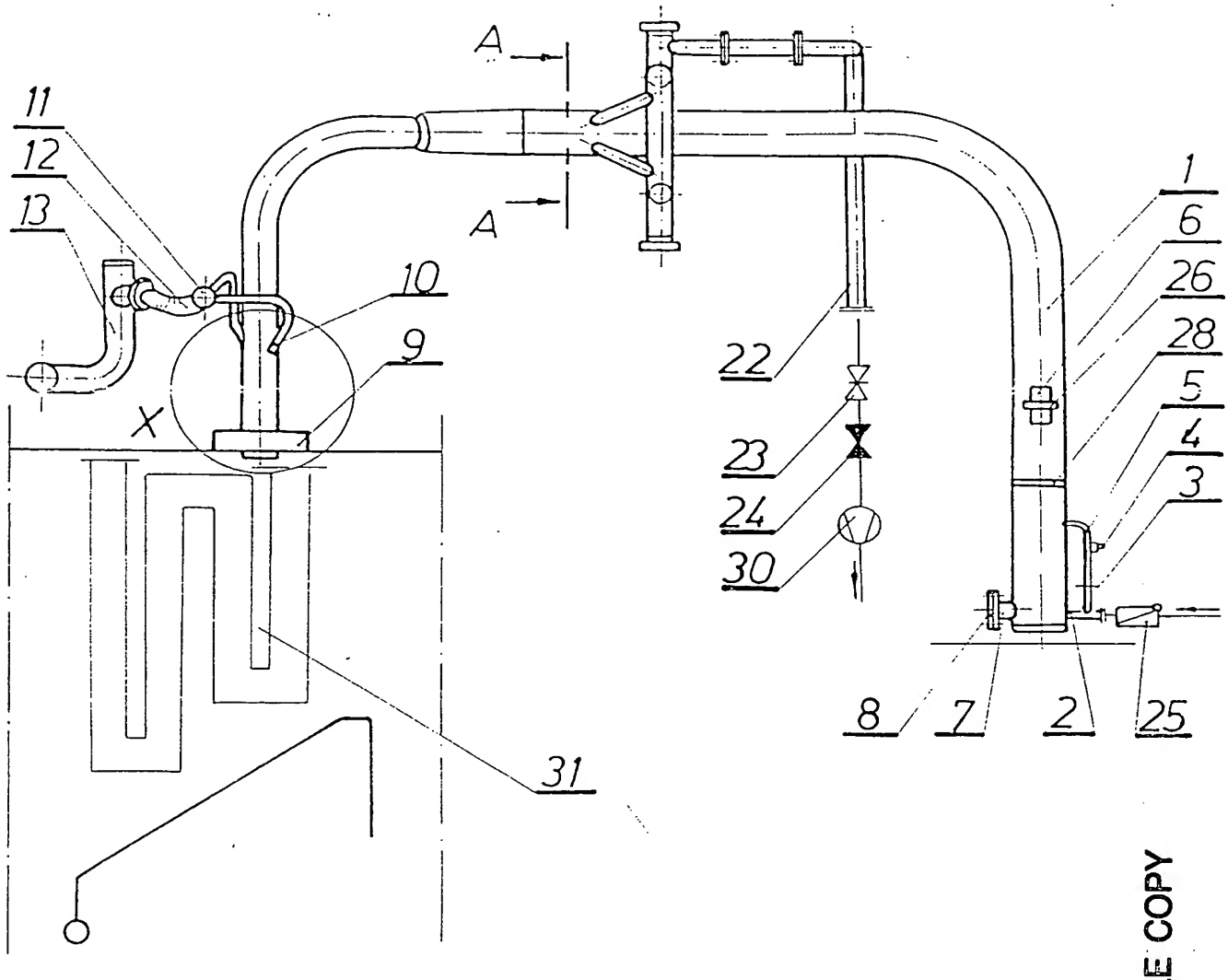
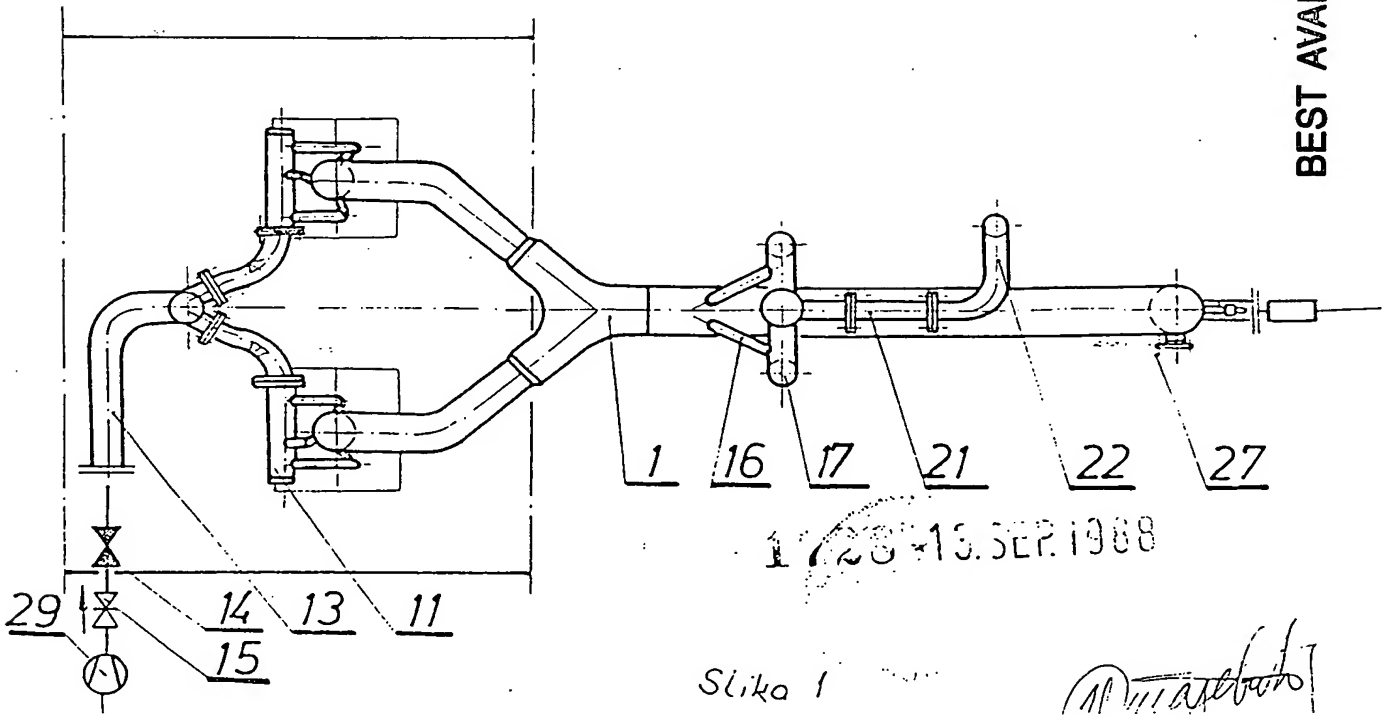
Uređaj za pouzdano detonaciono-impulsno čišćenje grejnih površina energetskih i drugih kotlova tokom pogona.





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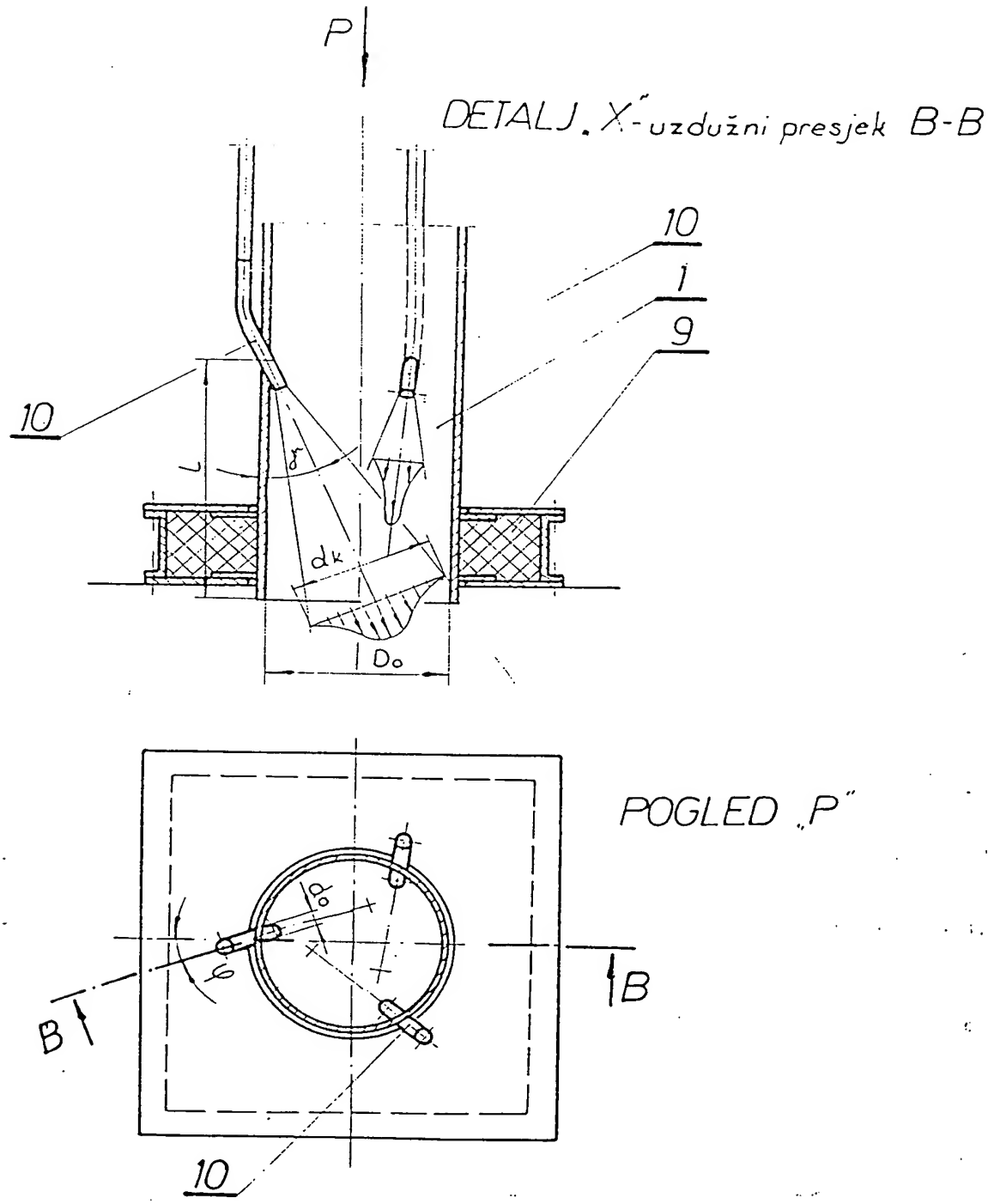

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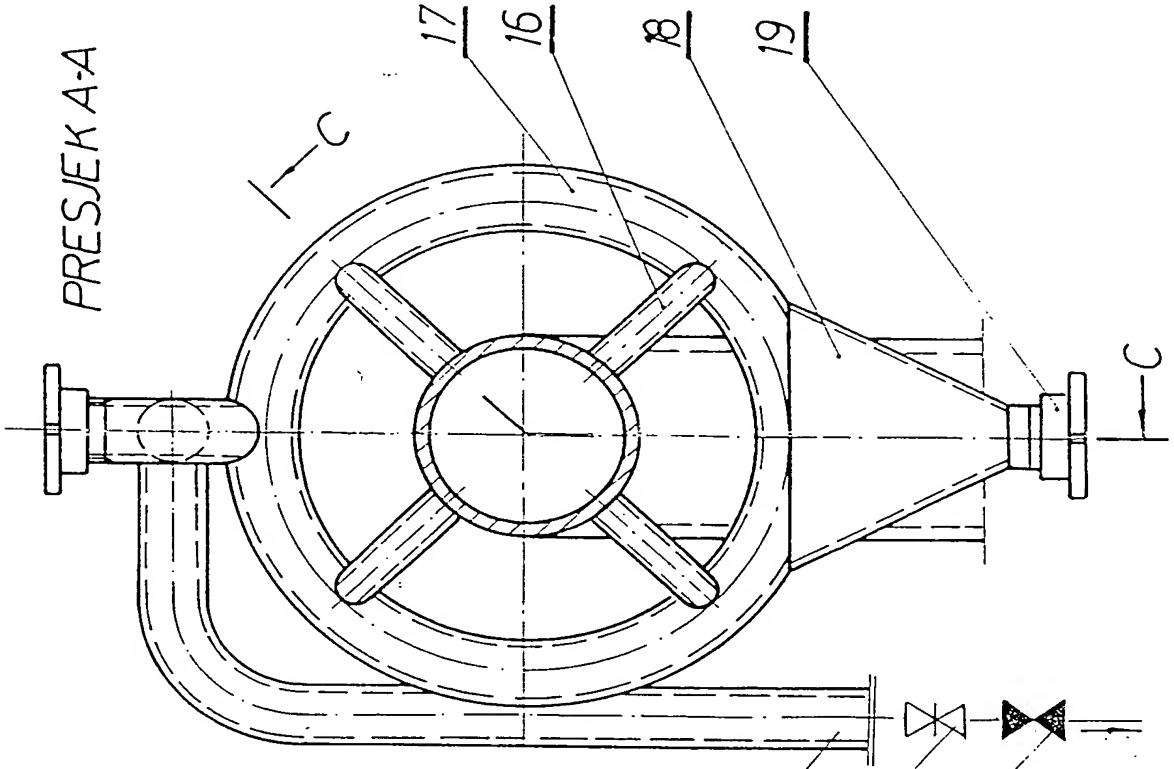
Uređaj za pouzdano detonaciono-impulsno čišćenje grejnih površina energetskih i drugih kotlova tokom pogona

List



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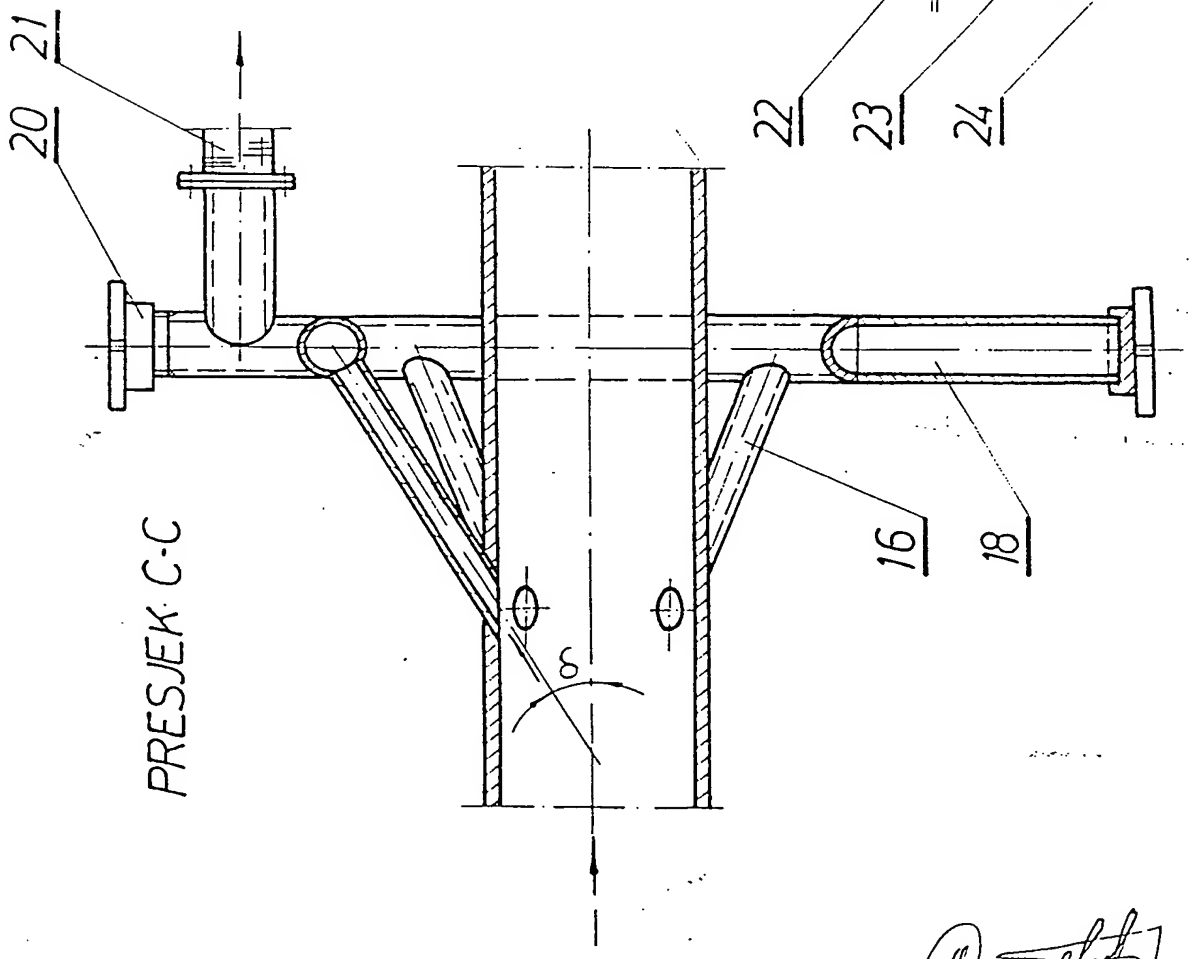

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